

We claim:

1. A system comprising:
  - a vibration assisted needle device comprising:
    - a housing defining a chamber;
    - a needle support for supporting a needle, the needle support being external to the housing;
    - converting means for being coupled to a rotational driving means, the converting means being supported within the chamber and being coupled to the needle support for converting rotational motion of the rotational driving means into reciprocatory motion of the needle support along a longitudinal axis of the needle to be supported by the needle support.
2. The system of claim 1, wherein the housing defines a longitudinal slot having an axis parallel to a longitudinal axis of the needle, the slot providing communication between the chamber and the needle support, and the needle support is coupled to the converting means through a post extending from the converting means through the longitudinal slot, the converting means providing a resultant force on the post causing reciprocation of the post along the longitudinal axis of the slot.
3. The system of claim 2, wherein the converting means is a bearing assembly.
4. The system of claim 3, wherein the bearing assembly is a ball bearing assembly.
5. The system of claim 1, further comprising rotational driving means external to the housing, for driving the converting means.
6. The system of claim 1, further comprising rotational driving means within the housing, for driving the converting means.

7. The system of claim 6, wherein the rotational driving means comprises a first cylinder, and the housing defines a chamber with a first portion for rotatably supporting the first cylinder and a passage for providing fluid to the chamber, to cause rotation of the cylinder.

8. The system of claim 7, wherein the converting means comprises a second cylinder and the housing defines a second portion of the chamber for rotatably supporting the second cylinder and a longitudinal slot having an axis parallel to a longitudinal axis of the needle, the second cylinder having an external surface defining a circumferential groove, at least a portion of the groove circumscribing the second cylinder at an oblique angle with respect to an axis of rotation of the second cylinder and at an oblique angle with respect to the axis of the slot, the system further comprising a coupling means extending through the slot for coupling the groove to the needle support such that rotation of the second cylinder causes reciprocation of the needle support.

9. The system of claim 1, further comprising a syringe support connected to an external surface of the housing.

10. The system of claim 1, further comprising a needle supported by the needle support.

11. The system of claim 10, further comprising a syringe support connected to an external surface of the housing and a syringe supported by the syringe support, the syringe being connected to the needle.

12. The system of claim 1, wherein the vibration assisted needle device comprises only non-ferromagnetic material.

13. A method of conducting a needle biopsy procedure, comprising:  
reciprocating a biopsy needle along its longitudinal axis;

advancing the reciprocating needle to a site of interest within a subject;  
collecting tissue at the site of interest; and  
withdrawing the needle.

14. The method of claim 13, comprising:

advancing the reciprocating needle with a stylet within a bore of the needle and  
withdrawing the stylet prior to collecting the tissue.

15. The method of claim 13, comprising reciprocating the needle prior to insertion of  
the needle into the subject and inserting the reciprocating needle into the subject.

16. The method of claim 13, comprising reciprocating the needle while collecting the  
tissue.

17. The method of claim 13, further comprising mounting the biopsy needle to a  
needle support of a device for causing reciprocation of the needle.

18. The method of claim 17, wherein the needle support is supported by the needle  
support external to the device.

19. The method of claim 17, wherein the needle support is supported within the  
device.

20. The method of claim 17, wherein the device causes reciprocation of the needle  
support along the longitudinal axis of the needle by converting rotational motion into  
reciprocatory motion.

21. The method of claim 17, comprising converting rotational motion into  
reciprocating motion with a bearing.

22. The method of claim 21, wherein the bearing is a ball bearing.

23. The method of claim 17, comprising converting rotational motion to reciprocatory motion by coupling the needle support to a circumferential groove on an external surface of a rotatable cylinder, the groove having at least a portion at an oblique angle with respect to an axis of rotation of the cylinder, the needle support being coupled to the groove through a slot in a housing, the slot having a longitudinal axis aligned with the longitudinal axis of the needle and at an oblique angle with respect to at least a portion of the groove, such that rotation of the cylinder causes reciprocation of the needle support along the longitudinal axis of the slot.

24. The method of claim 23, comprising rotating the cylinder hydraulically.

25. The method of claim 23, comprising rotating the cylinder by a rotational motor.

26. The method of claim 13, comprising reciprocating the needle support electromagnetically.

27. The method of claim 26, comprising reciprocating the needle by coupling the needle to a movable solenoid in a chamber of the device, energizing the solenoid and alternately attracting and repulsing the energized solenoid by a magnet in the chamber.

28. The method of claim 27, comprising alternately attracting and repulsing the movable solenoid by an energized stationary solenoid in the chamber.

29. The method of claim 28, further comprising alternately attracting and repulsing the movable solenoid by a second energized stationary solenoid, on an opposite side of the movable solenoid than the first solenoid.

30. The method of claim 13, wherein the needle is connected to a syringe with a plunger, the method further comprising:

stopping reciprocation of the needle;

withdrawing the plunger to create a negative pressure in a bore of the needle, prior to collecting the tissue at the site of interest; and then reciprocating the needle during tissue collection.

31. The method of claim 13, wherein the needle is connected to a pump, the method comprising activating the pump to create a negative pressure in a bore of the needle, prior to collecting the tissue at the site of interest.

32. The method of claim 13, further comprising guiding the needle to the site of interest by magnetic resonance imaging.

33. The method of claim 13, wherein the needle is a fine needle.

34. A method of conducting a needle biopsy procedure, comprising:  
reciprocating a biopsy needle along its axis;  
inserting the biopsy needle into a subject;  
advancing the reciprocating needle toward a site of interest;  
inserting the reciprocating needle into the site of interest; and  
collecting tissue at the site of interest.

35. A method of conducting a needle biopsy procedure with a device comprising a needle outside of a chamber, a reciprocating means within the chamber and a post coupling the needle to the reciprocating means, the method comprising:

reciprocating the post by the reciprocating means, to reciprocate the needle;  
advancing the reciprocating needle to a site of interest; and  
collecting tissue at the site of interest.